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NOTES, INFORMATION & NEWS

Kalidos griffithshauchleri, sp. nov., Madagascar's Largest Helicarionid Snail (Pulmonata)

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Introduction

Owen Griffiths of Mauritius (along with his associates and assistants) was a major participant in the author's 1992–1996 survey and inventory of Madagascar's land mollusks. Griffiths' unique and strongest contribution was in surveying the Reserve Naturelle Integrale de Tsingy de Bemaraha, a little-explored limestone karst region in west-central Madagascar. After some preliminary scouting in 1992 and 1993, Griffiths led expeditions in 1995 and 1996 into the southern and central-plus-northern parts of Bemaraha, respectively (Griffiths, 1995, 1996). Among the many new species of land snails resulting from Griffiths' Bemaraha collections (in Emberton, 1999a, b, 2001, 2002, in press) is the remarkable new *Kalidos* described herein.

The genus *Kalidos* Gude, 1911, is endemic to Madagascar; its sister group has been predicted from biogeographic considerations to lie among the ariophantines of India (Emberton & Rakotomalala, 1996). The *Faune de Madagascar* (Fischer-Piette et al., 1994) listed 71 *Kalidos* species (23 new), Emberton (1994) added one new species, and Emberton & Pearce (2000) added four new species. Thus this current new species brings the total to 77.

The author's 1992–1996 survey and inventory of Madagascar yielded over 2000 lots of *Kalidos* species. Only 438 of these lots have been identified so far, and the 1995–1996 Bemaraha *Kalidos* materials have not been reached yet in this process. However, three specimens of *K. **griffithshauchleri***, sp. nov. that were collected in 1992–1993 were sent to the author's attention some time ago and merit description now—in advance of the author's plan to monograph the genus—because of this species' unique size and its conservation implications for Bemaraha Reserve.

The author's identifications of 438 of the some 2000 lots of *Kalidos* have yielded 65 presumed species, of which 42 seem new and undescribed (Emberton, unpublished). Thus Madagascar's total *Kalidos* species now in collections is likely to be at least 250 (contradicting Emberton & Rakotomalala's 1996: table II estimate of "75?"). Most of those species are small, and none begins to approach this new species in its gigantic shell size. All other known and collected Madagascan helicarionids, with the exception of this gigantic Bemaraha species, are much smaller in size (Fischer-Piette et al., 1994; Emberton 1994; Emberton & Pearce, 2000; Emberton, unpublished).

Systematics

Higher classification follows Ponder & Lindberg (1997), Nordsieck (1986), and Vaught (1989). Type materials are placed in the Florida Museum of Natural History, University of Florida, Gainesville (UF) and the Australian Museum, Sydney (AMS). Description follows the format applied to other *Kalidos* by Emberton & Pearce (2000).

Class GASTROPODA

Clade HETEROBRANCHIA

Clade PULMONATA

Order STYLOMMATOPHORA

Suborder SIGMURETHRA

Infraorder HELICIDA

Superfamily HELICARIONOIDEA

Family HELICARIONIDAE

Subfamily ARIOPHANTINAE

Genus *Kalidos* Gude, 1911

*Kalidos **griffithshauchleri*** Emberton, sp. nov.

(Figure 1)

Kalidos sp. 1, Griffiths, 1995; Griffiths, 1996.

Diagnosis: Unique within the genus for its large initial whorls and very rapid whorl-expansion rate producing a gigantic adult shell. *Kalidos **griffithshauchleri***, sp. nov. is most similar to *K. bathensis* (Robson, 1914), from which it differs in both its larger initial whorls (diameters of first and first-plus-second whorls = 2.2 mm and 5.1 mm versus 1.7 mm and 3.8 mm) and its looser coiling (whorls/*ln*[diameter] 1.51–1.60 versus 1.76).

Holotype: UF285447 (1 adult), Owen Griffiths lot A1680: Madagascar: near Tsingy de Bemaraha: 15 km east of Antsalova: in cave mouth, April 1992.

Paratypes: UF285448 (1 adult), type lot. AMS C. 204776 (1 adult), Owen Griffiths lot A1737: Madagascar: near Tsingy de Bemaraha: southeast of Antsalova: near Tsiandro: in cave mouth, April 1993.

Description of holotype:

Shell Size and Shape. Shell rather thick and robust for

Figure. 1. *Kalidos* ***griffithshauchleri*** Emberton, sp. nov., holotype. Scale bar = 10 mm.

the genus. Diameter 58.5 mm, height 38.4 mm (h/d 0.66). Whorls 6.5 (coiling tightness = whorls/*ln*(diameter) = 1.6). Spire angle 155 degrees. Shell domed. Whorl periphery rounded. A faint, rather narrow, subsutural, spiral gutter is present throughout ontogeny. Suture depth one-half whorl from aperture is 1.4% of shell diameter. Subsutural line (where inside of shell wall meets previous whorl) not visible through shell. Umbilicus 3% of shell diameter, half covered by columellar reflection of apertural lip. Shell color whitish above, and a light yellowish brown below that grades to whitish on the base, marked both by a very conspicuous supraperipheral spiral band that is white, sharply bordered above and below by dark brown to purple-brown, and by a narrower and less conspicuous subsutural spiral band that is white bordered below by dark brown to purple-brown.

Aperture. Aperture width (measured parallel to a line between the columellar and upper peristome insertions) 45% of shell diameter. Aperture height-width ratio (height measured to and perpendicular to a line between the columellar and upper peristome insertions) 0.90. Distance between the columellar and upper peristome insertions 87% of aperture width. Penultimate whorl projects into body whorl, occupying 23% of aperture height. Lower peristome angle where it meets parietal wall (apertural view) 20 degrees.

Apex. First whorl diameter 2.2 mm. First two whorls diameter 5.1 mm. Embryonic whorls 2.1. Embryonic sculpture (partially eroded) of close-set, dense, wrinkled axial striae crossed by dense, fine spiral grooves.

Post-Embryonic Shell Sculpture. Close-set, obliquely axial striae, somewhat uneven in width, crossed by close-set spiral grooves to produce a pustulose appearance. Spiral grooves and their resulting pustules fading below the shell periphery, absent from the base, where only axial striae are visible.

Variation:

	Diameter	Ht/Diam	Whorls	Wh/*ln*Diam
Holotype	58.5	0.66	6.5	1.60
"Paratopotype"	56.3	0.60	6.1	1.51
Paratype	57.0	0.62	6.2	1.53

Griffiths (1996) reported a maximum diameter of 65 mm in the central and northern parts of Bemaraha Reserve.

The "paratopotype" is the freshest shell, with embryonic sculpture much more sharply detailed than in the holotype or other paratype.

Distribution: Bemaraha Reserve and its karstic vicinity, from the Manombolo River north to at least opposite the town of Antsalova, latitudes 18°02′–19°08′S, longitudes 44°32′–44°53′E (Griffiths, 1995, 1996).

Ecology: Griffiths (1995, 1996) reported, "This is the most obvious tsingy [=limestone karst] snail at Bemaraha. It can be found dead all over the tsingy in large numbers. Aestivates deep inside narrow tsingy slots where it sticks itself firmly to the substrate."

Etymology: For this species' co-discoverers, Owen Griffiths and Jorg Hauchler, both of Mauritius.

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Fungi and Other Items Consumed by the Blue-Gray Taildropper Slug (*Prophysaon coeruleum*) and the Papillose Taildropper Slug (*Prophysaon dubium*)

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Introduction

Six species of slugs, in addition to 29 other aquatic and terrestrial mollusk species, were listed in the Record of Decision for the Northwest Forest Plan (USDA and USDI, 1994). They were included in a list of rare taxa associated with late successional forests, referred to as Survey and Manage species, that require additional mitigation in order to assure their persistence. These species were listed, in part, due to the lack of information on their natural history and ecology.

Two Survey and Manage slug species were the focus of this study: the blue-gray taildropper (*Prophysaon coeruleum* Cockerell, 1890) and the papillose taildropper (*P. dubium* Cockerell, 1890). Studies have shown slugs of other species to be mycophagists (Buller, 1922; Chatfield, 1976; Pallant, 1969). Field observations of these two *Prophysaon* slug species on and within partially eaten fungi suggested that they are also mycophagous. We tested this hypothesis by examining fecal pellets from these slug species for evidence of ingested fungal material.

Materials and Methods

P. coeruleum and *P. dubium* were collected during field surveys within several proposed timber sale areas in Douglas County, Oregon on Bureau of Land Management lands from March 1998 through May 1999. These were

Table 1

Frequency of food item occurrence in fecal samples of *Prophysaon coeruleum* and *Prophysaon dubium*. (Total # of samples and % of samples containing item).

	Prophysaon coeruleum						*Prophysaon dubium*					
Single food item	Spring (n = 34)		Fall (n = 52)		Spring and fall (n = 86)		Spring (n = 20)		Fall (n = 37)		Spring and fall (n = 57)	
Plant tissue	25	74%	26	50%	51	59%	14	74%	26	59%	40	63%
Lichens	0	0	13	25%	13	15%	2	10%	8	18%	10	16%
Imperfect fungi	4	12%	6	12%	10	12%	5	26%	4	9%	9	14%
Fungal hyphae*	25	74%	42	81%	67	78%	11	58%	32	73%	43	68%
Fungal spores*	8	24%	32	62%	40	47%	1	5%	37	84%	38	60%
Unidentified	0	0	2	4%	2	2%	2	10%	1	8%	3	5%

* Data does not include imperfect fungi.

predominantly Douglas fir timber stands ranging in age from 50 years to over 200 years old with average tree diameters at breast height (DBH) of 50 cm to over 100 cm. The majority of fecal samples were collected from slugs located in stands over 80 years of age. Surveys were done during the spring and fall when the forest litter layer was moist and the ambient air temperature was between 4°C and 11°C. The established protocol for Survey and Manage terrestrial mollusks (Furnish et al., 1997) was followed. Time-constrained surveys were conducted in suitable habitat with emphasis on suspected areas of high-quality habitat. Two 81 m^2 plots in every 4 hectares of project area, specifically located in high-quality habitat, were intensively searched for 20 minutes each. Another 20 minutes was spent at other sites throughout the remainder of the 4 ha conducting brief, 1–5 minute opportunistic searches.

Specimens of either *P. coeruleum* and *P. dubium* were placed individually in clean, white film canisters until they produced fecal pellets (typically within 1–4 hours). Fecal pellets from individual animals were taken as they were produced from the animal or were collected where they fell on the surfaces of the canisters. No substrate or plant material from the discovery site was placed in the canister with the animal. Fecal pellets were removed from the canisters and immediately placed in a vial of 70% isopropyl alcohol. The animals were returned to the site of collection or kept as vouchers. Identification of slug species was done by examination of external physical characteristics only. Only specimens which conformed to the described species were used in this study. Voucher specimens currently reside at the Roseburg, Oregon Field Office of the Bureau of Land Management.

For fecal analysis, pellets were moved to small vials of 50% ethanol to dissolve lipid layers of viruses which might pose health threats to humans (Colgan et al., 1997). One to two drops of distilled water were then added to rehydrate the samples for 48 hours at room temperature. Pellets were macerated and mixed thoroughly. The resulting suspension was transferred to a microscope slide. One to two drops of Melzer's reagent (iodine, potassium iodide, and chloral hydrate in aqueous solution) were added and the suspension then covered with a 22 × 22 mm cover slip. One slide was made per sample. Seventy-five fields, each 450 μm in diameter, across three horizontal lines of view were then examined on each slide at 250× magnification with a compound microscope. Fungal spores were identified to family, genus, or species according to Castellano et al. (1989). Plant material, lichens, molds, fungal hyphae, and other fungal structures, as well as occasional arthropod fragments and nematodes, were recorded.

Quantitative analysis of the frequency of detections of ingested material was not the intended focus of this study, and the methods used were not quantitatively rigorous. For instance, fecal pellets were not equal in volume, resulting in unequal dilutions in slide preparations. However, an apparent difference was observed in the proportions of fungal and plant material detected in spring samples as compared to fall samples. We investigated this trend using Chi-square tests to detect significant differences ($a = 0.05$) in the frequency of the types of materials identified between fall and spring seasons, and between slug species within seasons. No significance tests were done on the fungal taxa due to the small sample sizes within several fungal taxa.

Results and Discussion

Both *Prophysaon* species in this study showed evidence of consumption of fungi (spores or hyphae of mushrooms or truffles), vascular plant material (both root tissue and other plant tissue), lichens, and imperfect fungi, i.e., molds in their fecal samples (Table 1). Fungi were the most common items found in both *P. coeruleum* 90% (77/86) and *P. dubium* 82% (47/57) samples, with spores from 10 separate fungal families identified. In addition, fragments of arthropods were found in 8% (11/143) of the samples, and nematodes were found in 6% (8/143) of the samples. Nematodes were seen to be whole and in